Population-Based Prevalence of Cocaine in Newborn Infants—Georgia, 1994

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Note: This paper is an outline of a poster presentation made at the 1998 GIS in Public Health Conference, Phoenix, Arizona. For other reports about the study discussed in this paper, see the Centers for Disease Control and Prevention's Morbidity and Mortality Weekly Report (MMWR) of October 18, 1996 (1) at http://www.cdc.gov/epo/mmwr/preview/mmwrhtml/00044121.htm, or the Georgia Epidemiology Report of February 1997 (2) at http://www.ph.dhr.state.ga.us/epi/manuals/ger/feb97ger.pdf (adapted from the MMWR article).

Abstract

In 1994, the Georgia March of Dimes Birth Defects Foundation, the Georgia Department of Human Resources, and the federal Centers for Disease Control and Prevention collaborated to assess the feasibility of using dried blood spots (DBSs), routinely collected from newborn infants for metabolic disease screening, to conduct low-cost population-based screening to ascertain the prevalence of cocaine exposure. This is the first known application of population-based screening of newborns to detect exposure to cocaine. Georgia birth certificate records were electronically linked to metabolic records using probabilistic linkage. Maternal and infant characteristics associated with increased infant mortality were kept for analysis, and personal identifiers and linkage information were removed. The cocaine testing was performed on blinded DBSs using a modified radioimmunoassay to screen for benzoylecognine (BE). Positives were confirmed by mass spectrometry. The analysis file includes 17,230 infants born during a two-month period; of these infants, 91% had a DBS. Infants who were older than seven days, who had had less than 31 weeks of gestation, or whose birth weight was less than 1,500 grams were excluded. Specimens for 73 infants (4.7 per 1,000 statewide) tested positive for BE. Maternal characteristics associated with increased rates of BE in infants include greater age, three or more previous live births, cigarette smoking or alcohol drinking by the mother during pregnancy, inadequate weight gain during pregnancy, no father's name on birth certificate, black race, a short interpregnancy interval, education less than three years of college, late or no prenatal care with fewer visits, and delivery in perinatal centers or hospitals with no obstetric services. Six infants in the study were not delivered at a hospital. Mothers of BE-positive infants resided in 16 of the 19 health districts in Georgia, but 45% resided in a particular district. Antepartum cocaine

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exposure is found in newborn infants throughout Georgia and in diverse population groups. This methodology is suitable for screening large populations and can be adapted for use with other substances of abuse.

Keywords: cocaine, newborns, zip code, surveillance, pregnancy

Background

A political history of the study of cocaine in newborns, and this study's time line:

- Late 1980s: Perceived cocaine epidemic
- 1990: Infant Health in Georgia report
- 1990: Georgia General Assembly Conference on Children of Cocaine
- 1990–1993: Protocol and prototype study
- 1994: Specimen collection and test for cocaine
- 1995: Data analysis and report writing
- 1996: Publication—*Morbidity and Mortality Weekly Report,* October 18, 1996 (1)
- 1996: Ground breaking for the March of Dimes Home of New Beginnings

Public policy recommendations from the Georgia General Assembly Conference on Children of Cocaine:

- Base public health policy on valid research
- Legislate comprehensive, holistic approach to control of substance abuse crisis
- Declare moratorium on legislation that could prosecute drug-dependent pregnant women
- General Assembly should develop and fund appropriate substance abuse treatment facilities for pregnant women

Methods

Research goals:

- Determine prevalence of cocaine-positive infants
- Determine geographic distribution
- Determine if cocaine-positive mothers get health care
- Identify possible interventions for mothers
- Define the methodology: strengths, weaknesses, biases

The analysis files, designed to assure anonymity of mothers:

- "Selection file" to study biases—no lab test results
- 21 analysis files with lab test results
- No file with more than four maternal characteristics
- No category with fewer than 50 infants

Strengths of the method:

- Population-based
- Large sample
- Low cost per individual tested
- Linked data to define birth cohort and to improve quality of data on maternal characteristics

Weaknesses of the method:

- Requires high-quality laboratory
- Bias against including premature infants
- Requires linkage to birth file for good epidemiology
- Fear of prosecution mandates extreme concern for anonymity
- Anonymity requirements limit datafiles for careful definition of maternal characteristics

Results

See Tables 1 through 5 and Figures 1 through 3.

Table 1 Rate of Maternal Cocaine Use by Selected Socio-Demographic Characteristics

Maternal and Child Characteristics	Sample Size	Number Positive	Rate per 1,000	Poisson 95% CI	
				Low	High
Age group (years)					
<20	2,975	2	0.7	0.1	2.4
20–24	4,168	15	3.6	2.0	5.9
25–29	3,921	34	8.7	6.0	12.1
30 or over	3,903	22	5.6	3.5	8.5
Missing	1	0	*	*	*
Education (years)					
<12	3,449	25	7.2	4.7	10.7
12	5,406	34	6.3	4.4	8.8
13–14	2,482	12	4.8	2.5	8.4
15 or more	3,511	2	0.6	0.1	2.1
Missing	120	0	0.0	0.0	30.7
Race/Ethnicity					
Other	287	0	0.0	0.0	12.9
White Hispanic	491	0	0.0	0.0	7.5
White non-Hispanic	9,139	12	1.3	0.7	2.3
Black	5,049	61	12.1	9.2	15.5
Missing	2	0	*	*	*
Urban Residence					
Large MSA/city	2,766	39	14.1	10.0	19.3
Small MSA/city	1,643	9	5.5	2.5	10.4
Non-MSA/city	1,051	6	5.7	2.1	12.4
Large MSA/non-city	4,705	9	1.9	0.9	3.6
Small MSA/non-city	1,360	3	2.2	0.5	6.4
Non-MSA/non-city	3,442	7	2.0	0.8	4.2
Missing	1	0	*	*	*
Marital Status					
Married	9,851	19	1.9	1.2	3.0
Not married	5,116	54	10.6	7.9	13.8
Missing	1	0	*	*	*
Total	14,968	73	4.9	—	—

* = sample size less than 5

— = not applicable

CI = confidence interval

MSA = metropolitan statistical area

Table 2 Rate of Maternal Cocaine Use by Selected Health Care Information

Health Care Characteristics	Sample Size	Number Positive	Rate per 1,000	Poisson 95% CI	
				Low	High
Adequacy of prenatal care					
None	167	15	89.8	50.3	148.1
Inadequate	1,702	27	15.9	10.5	23.1
Intermediate	2,236	3	1.3	0.3	3.9
Adequate	6,780	12	1.8	0.9	3.1
Adequate plus	3,920	12	3.1	1.6	5.3
Missing	163	4	24.5	6.7	62.8
Perinatal hospital service level					
None	149	6	40.3	14.8	87.6
Minimal (Level I)	2,817	10	3.5	1.7	6.5
Intermediate (Level II)	4,844	12	2.5	1.3	4.3
Specialized (Level III)	4,649	16	3.4	2.0	5.6
Regional perinatal center	2,503	29	11.6	7.8	16.6
Missing	6	0	—	—	—
Teaching hospital					
Yes	3,719	36	9.7	6.8	13.4
No	11,243	37	3.3	2.3	4.5
Missing	6	0	—	—	—
Trimester prenatal care began					
None	167	15	89.8	50.3	148.1
First (1–3 months)	12,080	25	2.1	1.3	3.1
Second (4–6 months)	2,139	21	9.8	6.1	15.0
Third (after 6 months)	447	8	17.9	7.7	35.3
Missing	135	4	29.6	8.1	75.9
Total	14,968	73	4.9	—	—

— = not applicable

CI = confidence interval

Table 3 Rate of Maternal Cocaine Use by Selected Maternal Risk Factors

Maternal Risk Factor	Sample Size	Number Positive	Rate per 1,000	Poisson 95% CI Low	Poisson 95% CI High
Smoking tobacco and/or drinking alcohol during pregnancy					
Both	106	13	122.6	65.3	209.7
Tobacco only	1,584	28	17.7	11.7	25.5
Alcohol only	111	3	27.0	5.6	79.0
Neither	13,117	29	2.2	1.5	3.2
Missing	50	0	—	—	—
Weight gain during pregnancy (pounds)					
Less than 15	996	13	13.1	6.9	22.3
15–24	3,001	18	6.0	3.6	9.5
25 or more	9,995	35	3.5	2.4	4.9
Missing	1,016	7	6.9	2.8	14.2
Previous births					
None	6,520	6	0.9	0.3	2.0
1	5,015	14	2.8	1.5	4.7
2	2,262	16	7.1	4.0	11.5
3 or more	1,171	37	31.6	22.2	43.6
Interpregnancy interval (months)					
No previous birth	6,520	6	0.9	0.3	2.0
0–6	675	15	22.2	12.4	36.7
7 or more	7,542	44	5.8	4.2	7.8
Unknown	231	8	34.6	15.0	68.2
Father's name present on birth certificate					
Yes	12,360	32	2.6	1.8	3.7
No	2,608	41	15.7	11.3	21.3
Total	14,968	73	4.9	—	—

— = not applicable

CI = confidence interval

Table 4 Relative Risk of Maternal Cocaine Use by Selected Maternal Risk Factors

Maternal Risk Factor	Sample Size	Number Positive	Rate per 1,000	Poisson 95% CI Low	Poisson 95% CI High
Smoking tobacco and/or drinking alcohol during pregnancy					
Both	106	13	55.5	38.8	79.4
Tobacco only	1,584	28	8.0	5.2	12.4
Alcohol only	11	3	12.2	4.8	30.9
Neither	13,117	29	1.0	+	+
Missing	50	0	—	—	—
Father's name present and marital status					
Neither	2,437	34	11.3	6.7	18.9
Married only	170	7	33.2	18.5	59.5
Father's name only	2,679	20	6.0	3.2	11.3
Both	9,681	12	1.0	+	+
Missing	1	0	—	—	—
Age at conception and parity					
25 or older and 2 or more children	2,348	43	15.8	8.8	28.6
Under 25 and 2 or more children	1,085	10	8.0	3.5	17.9
25 or older and 1 or no children	5,476	13	2.1	0.8	5.0
Under 25 and 1 or no children	6,058	7	1.0	+	+
Adequacy of prenatal care and parity					
Inadequate and 2 or more children	671	36	54.6	37.1	80.3
Inadequate and 1 or no children	1,361	10	7.5	3.6	15.7
Adequate and 2 or more children	2,762	17	6.3	3.2	12.4
Adequate and 1 or no children	10,174	10	1.0	+	+
Gestational age and weight gain during pregnancy					
Preterm infant and <25 pounds gained	877	23	10.0	6.3	16.0
Preterm infant and 25+ pounds gained	1,145	12	4.0	2.1	7.6
Term infant and <25 pounds gained	4,136	15	1.4	0.7	2.7
Term infant and 25+ pounds gained	8,810	23	1.0	+	+
Total	14,968	73	4.9	—	—

— = not applicable

+ = reference value

CI = confidence interval

Table 5 Rate of Maternal Cocaine Use by Selected Pregnancy Outcomes

Maternal and Child Characteristics	Sample Size	Number Positive	Rate per 1,000	Poisson 95% CI	
				Low	High
Birth weight category (grams)					
Normal (2,500 and over)	14,256	57	4.0	3.0	5.2
Low (1,500–2,499)	703	16	22.8	13.0	37.0
Gestational age (weeks)					
38 or more	12,9426	38	2.9	2.1	4.0
32–37	2,003	29	14.5	9.7	20.8
Missing	19	6	315.8	115.9	687.3
Total	14,968	73	4.9	—	—

— = not applicable

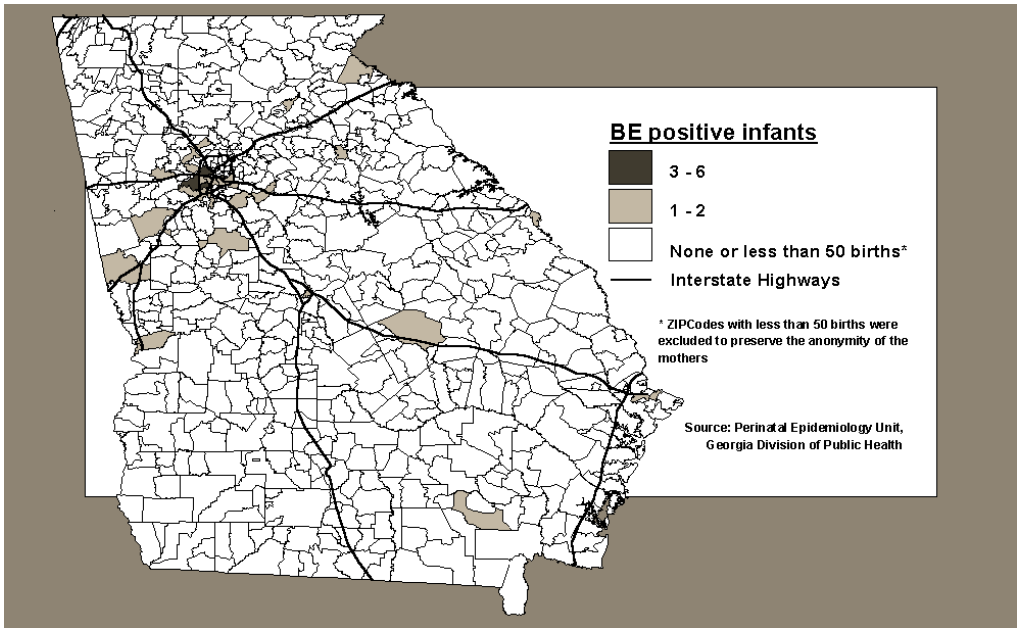

Figure 1 Geographic distribution of cases of benzoylecognine (BE)—a cocaine metabolite—in newborn infants, by zip code of mother's residence; Georgia, February 22 through April 23, 1994.

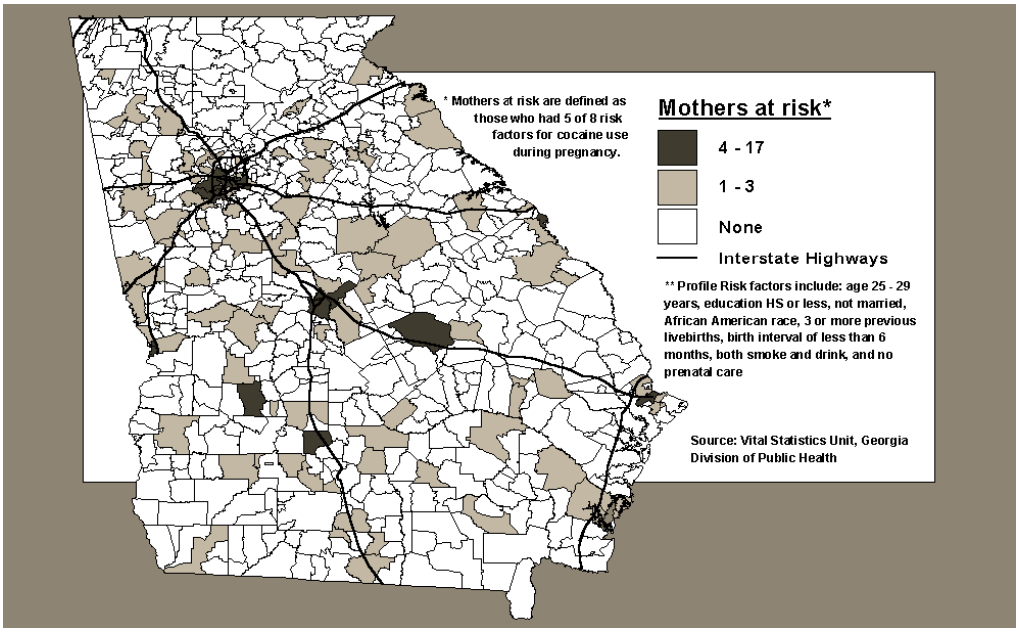

Figure 2 Areas with mothers at high risk for using cocaine during pregnancy (as defined by a risk profile** developed from the study), by zip code of mother's residence; Georgia, February 22 through April 23, 1994.

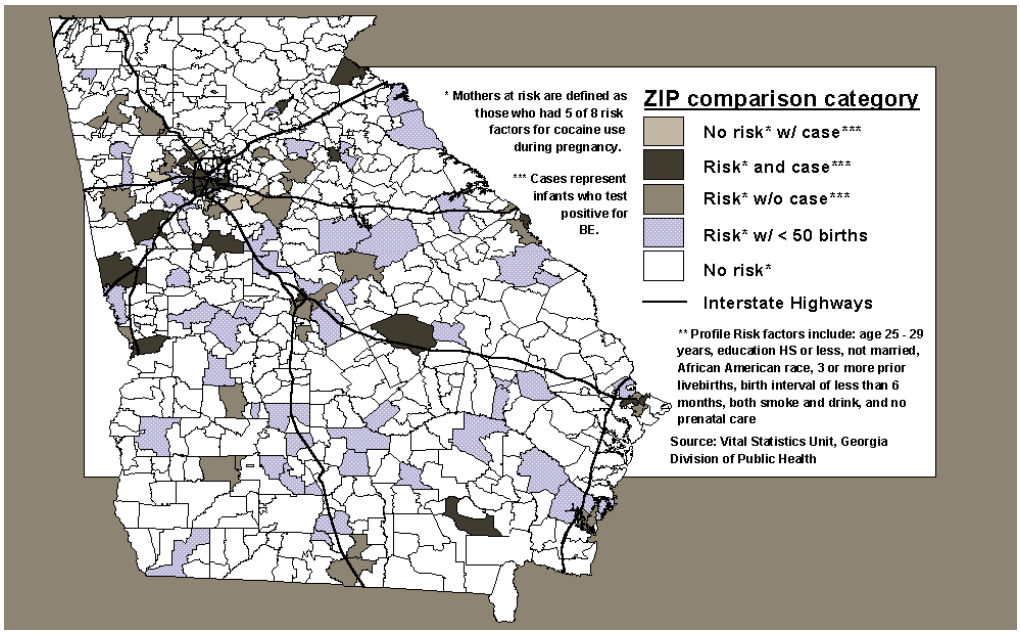

Figure 3 Comparison of high-risk zip codes identified by a risk profile developed from the study and zip codes with confirmed cases of infants testing positive for BE, by zip code of mother's residence; Georgia, February 22 through April 23, 1994.

Conclusions

Highlights of the study:

- Higher rates observed among users of other substances (tobacco and alcohol)
- Higher rates observed in women 25 and older, and in women who have had children before
- Higher rates observed in the city; however, events were observed throughout Georgia
- Higher rates received late or no prenatal care; however, three-quarters of mothers of BE-positive infants receive some prenatal care, and one-third receive care in the first trimester
- Some women deliver outside a hospital environment

A Georgia perspective on infant health and maternal behaviors during pregnancy that can adversely affect the fetus:

- Infant health
  - — 1 in 50 have very low birth weight (less than 3 pounds, 5 ounces)
  - — 1 in 50 have a major birth defect
  - — 1 in 200 have perinatal exposure to cocaine
  - — 1 in 500 test positive for HIV (maternal antibody); an estimated 15% to 20% of these will develop AIDS
  - — 1 in 4,000 are born with fetal alcohol syndrome

See Figures 4 through 7.

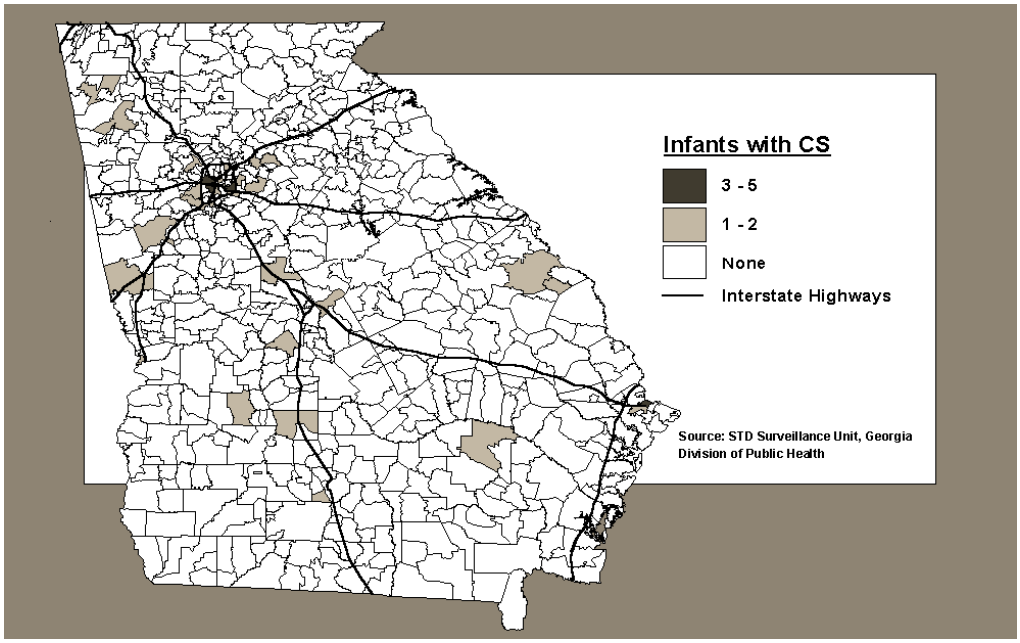

Figure 4 Geographic distribution of cases of congenital syphilis (CS) in newborn infants, by zip code of mother's residence; Georgia, 1994.

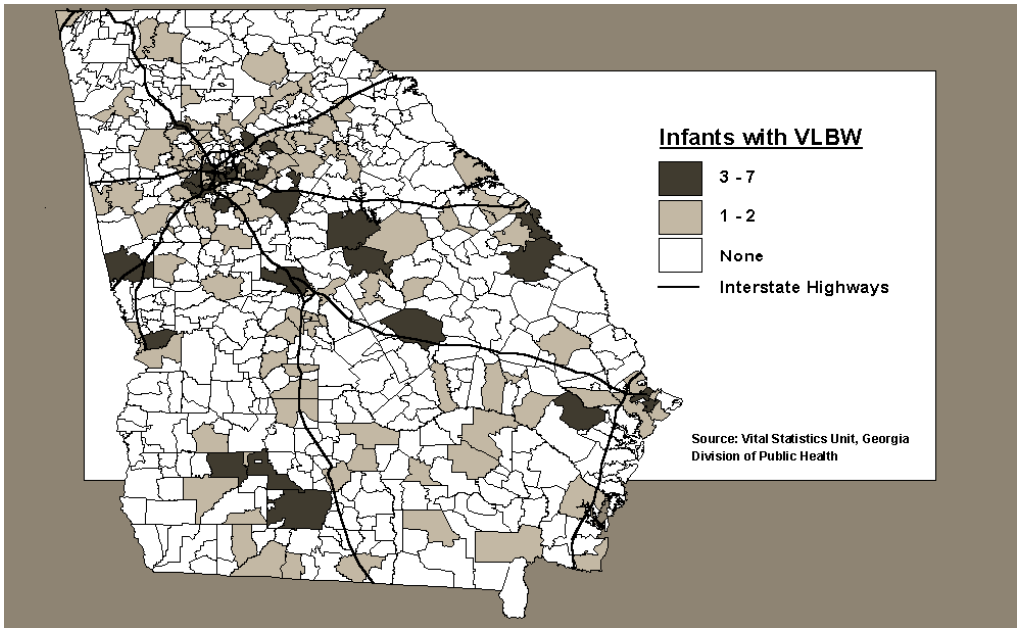

Figure 5 Geographic distribution of newborn infants with very low birth weight (VLBW), by zip code of mother's residence; Georgia, February 22 through April 23, 1994.

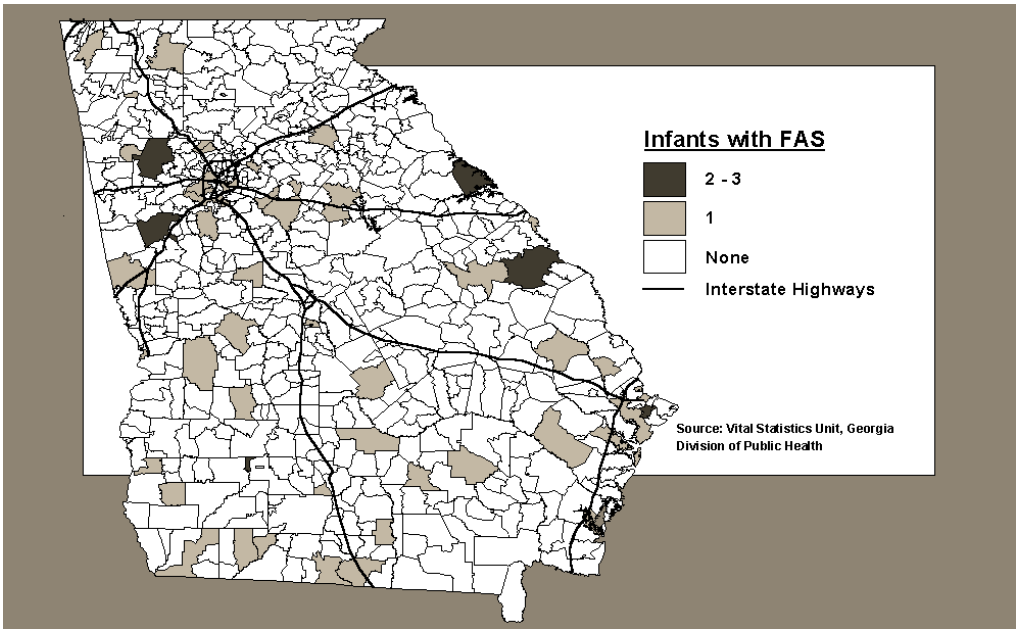

Figure 6 Geographic distribution of fetal alcohol syndrome (FAS) in newborn infants, by zip code of mother's residence; Georgia, 1990 through 1994.

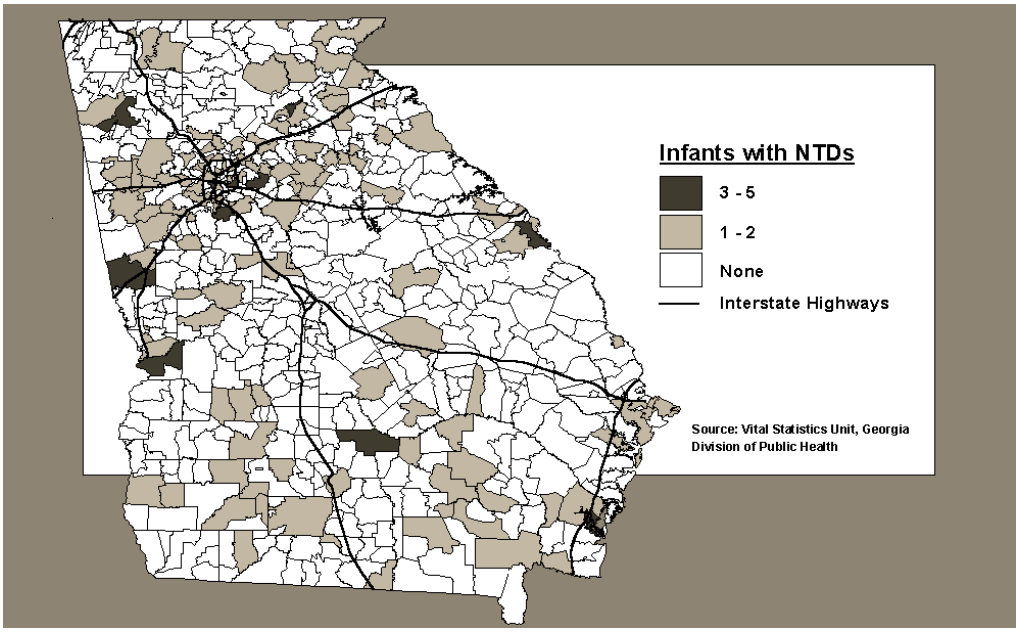

Figure 7 Geographic distribution of neural tube defects (NTDs) in newborn infants, by zip code of mother's residence; Georgia, 1990 through 1994.

- Maternal behaviors
  — 1 in 2 are not taking multivitamins with folate during pregnancy
  — 1 in 6 smoke tobacco during pregnancy
  — 1 in 10 consume alcohol during pregnancy
  — 1 in 100 receive no prenatal care
  — 1 in 200 use cocaine during pregnancy

See Figures 8 through 10.

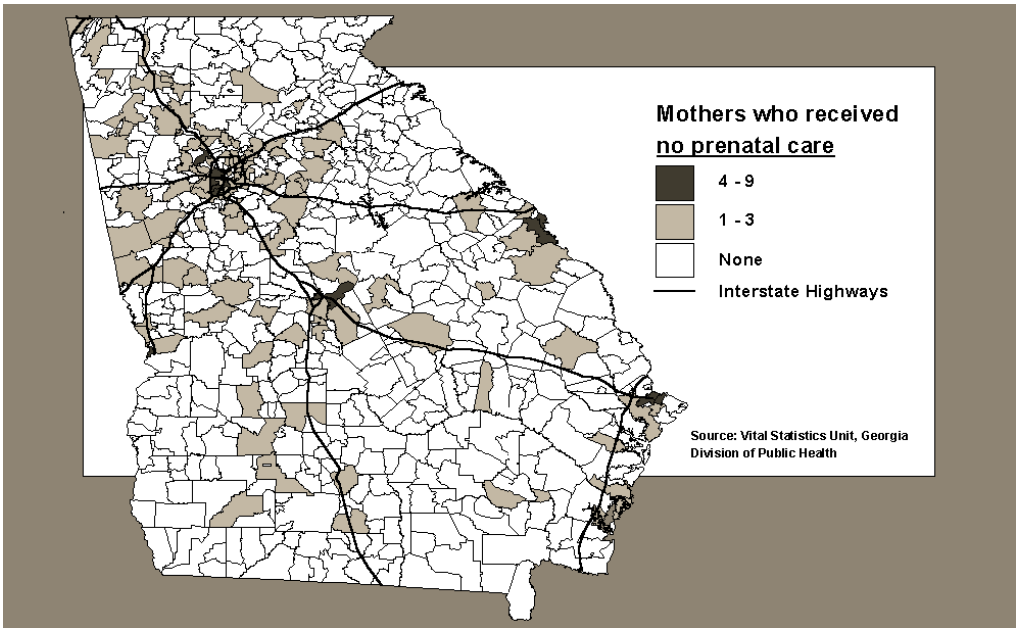

Figure 8 Geographic distribution of mothers who received no prenatal care during pregnancy, by zip code of mother's residence; Georgia, February 22 through April 23, 1994.

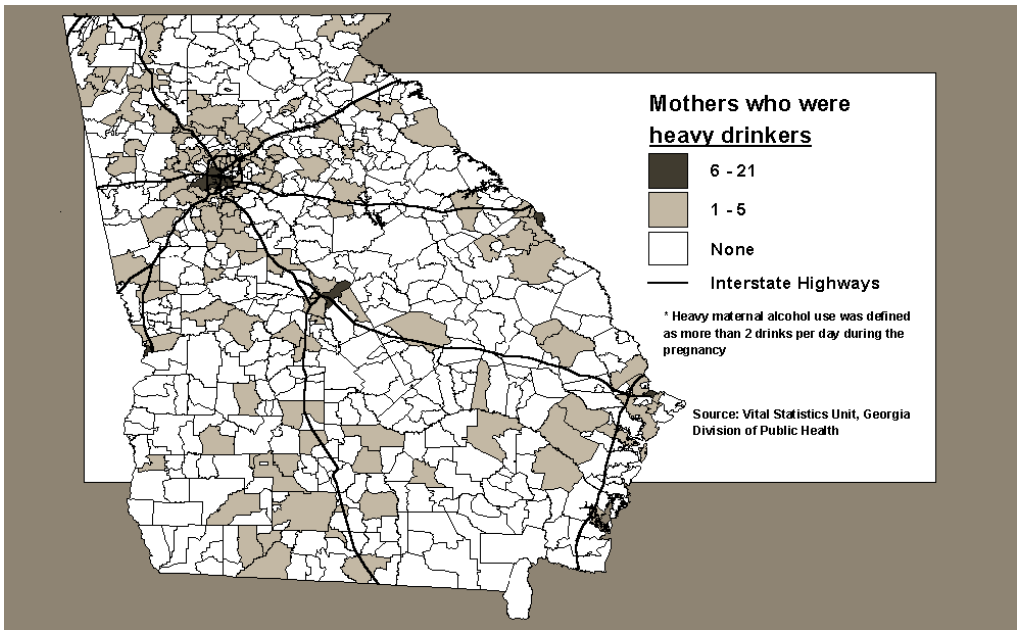

Figure 9 Geographic distribution of heavy maternal alcohol use* during pregnancy, by zip code of mother's residence; Georgia, 1990 through 1994.

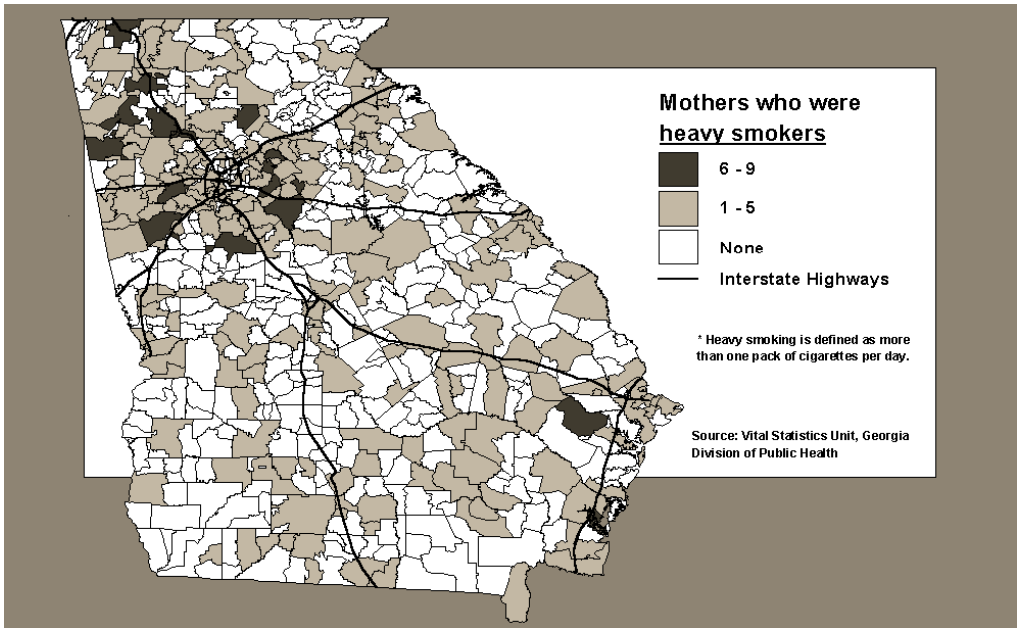

Figure 10 Geographic distribution of heavy maternal smoking* during pregnancy, by zip code of mother's residence; Georgia, February 22 through April 23, 1994.

Acknowledgments

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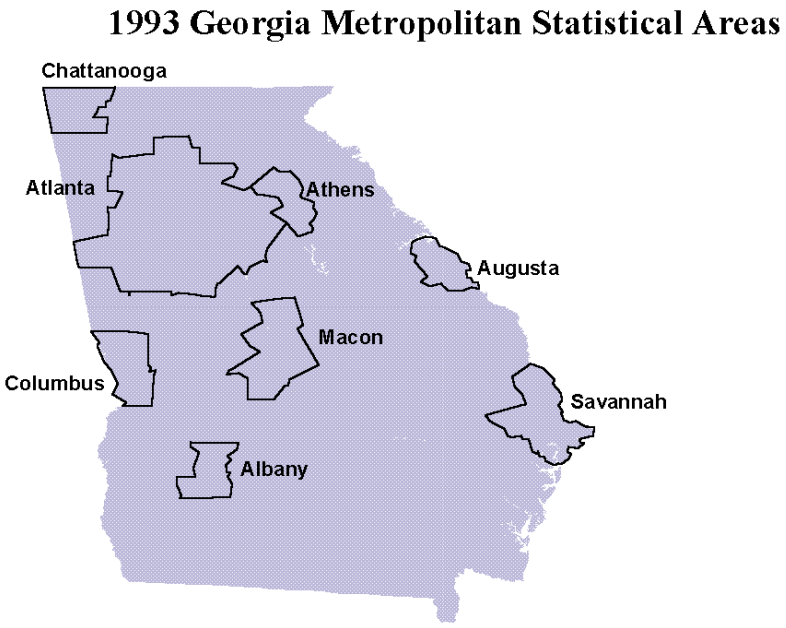
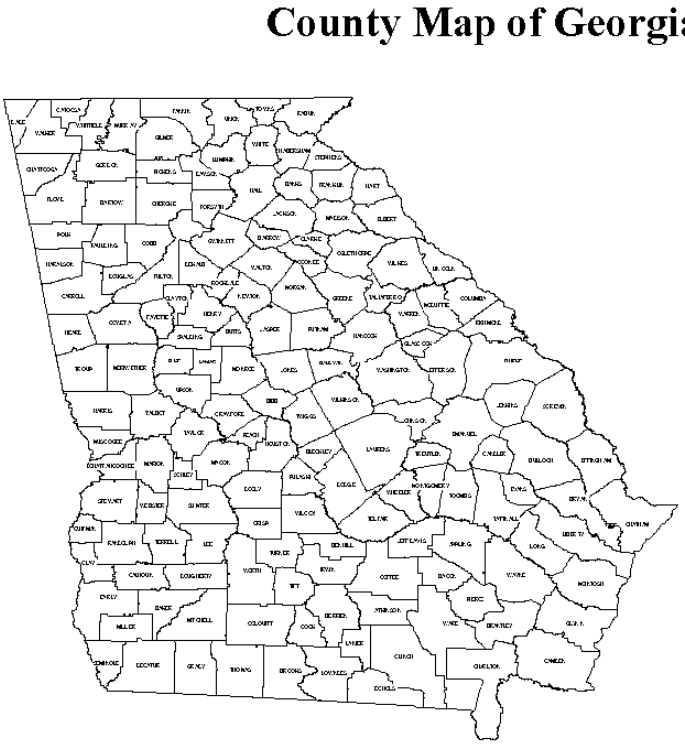
References

1. Centers for Disease Control and Prevention. 1996. Population-based prevalence of perinatal exposure to cocaine—Georgia, 1994. *Morbidity and Mortality Weekly Report* 45(41):887–91. October 18.
2. Rochat R, Brantley M, Floyd V, Norris D, Franko E, Blake P, Toomey, Fernhoff P, Ziegler B, Mayer L, Henderson O, Hannon H, Martin L, Ferre C. 1997. Population-based prevalence of perinatal exposure to cocaine in Georgia, 1994. *Georgia Epidemiology Report* 13(2):1–3. February.
3. Henderson LO, Powell MK, Hannon WH. 1997. An evaluation of the use of dried blood spots from newborn screening for monitoring the prevalence of cocaine use among childbearing women. *Biochemical and Molecular Medicine* 61(2):143–51.


1993 Georgia Metropolitan Statistical Areas
Chattanooga
Atlanta
Athens
Augusta
Macon
Columbus
Savannah
Albany

Map 1


County Map of Georgia

Map 2